United States
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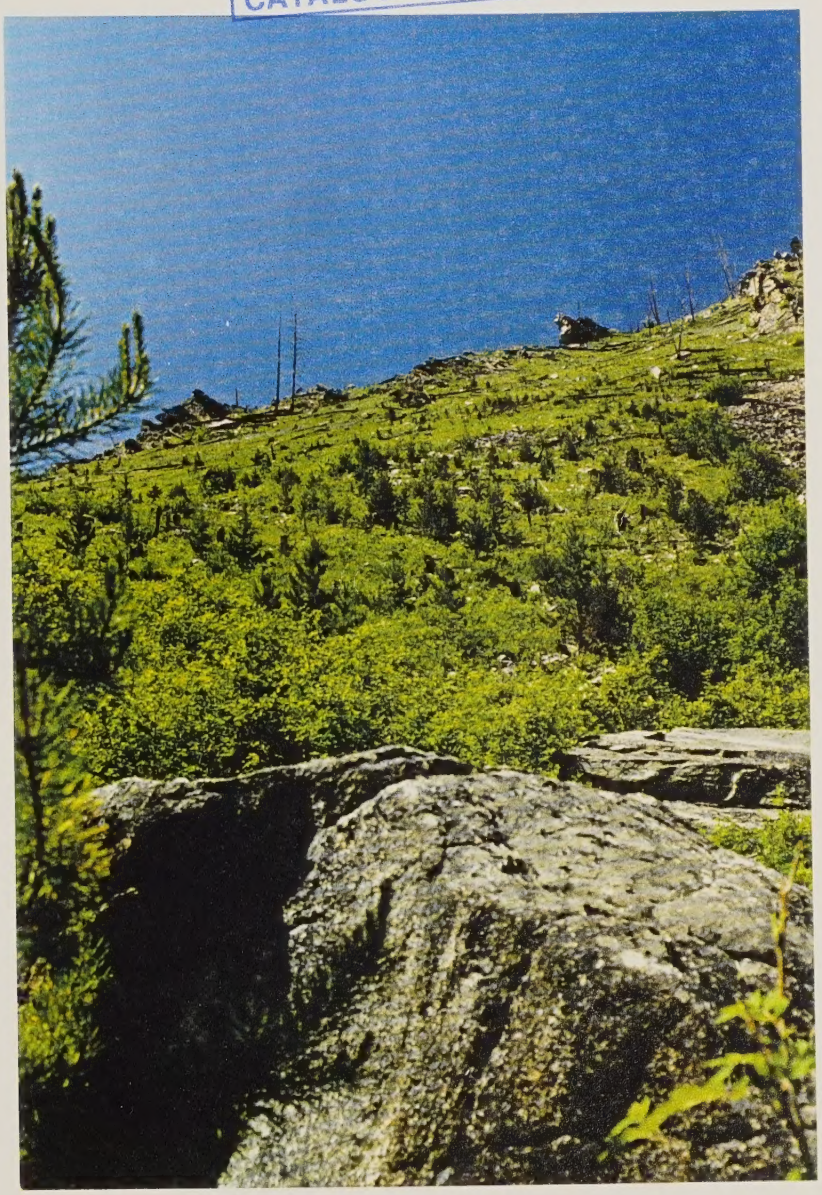
MTDC/FHP Technology Development Program FY 96 Accomplishment Report



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November 1996

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MTDC/FHP Technology Development Program FY 96 Accomplishment Report

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MISSOULA TECHNOLOGY AND DEVELOPMENT CENTER
FY 96 ACCOMPLISHMENT REPORT
MTDC/FHP TECHNOLOGY DEVELOPMENT PROGRAM

Executive Summary

This was an important year for the Missoula Technology Development Center/Forest Health Protection (MTDC/FHP) Program as it became integrated into the Forest Health Technology Enterprise Team (FHTET) organization established by FHP. Considerable effort was expended in demonstrating MTDC capabilities to FHTET and MTDC is pleased to be associated with the team.

MTDC worked on eight projects in FY 96 under the MTDC/FHP Technology Development Program and two additional FHP projects, one that originated as a direct transfer of funds during FY 96 and one that is operating on funding transferred from Region 8. The year was productive with progress made on all projects. The primary change in the program over the course of the year was a redistribution of resources from Non-Chemical Orchard Cone Sanitation (3E32P11) to other projects. This change was due to entomological conditions at the seed orchard and allowed the program to take advantage of opportunities that developed in other projects to meet near term customer needs.

Introduction

Missoula Technology and Development Center (MTDC) and Forest Health Protection (FHP) have developed a relationship over the past three decades in which FHP technical objectives are supported by MTDC technical expertise and products. The projects in the FY 96 Plan of Work are a combination of new development projects and ongoing development efforts. A mainstay of the program is the Technical Services Project which allows MTDC personnel to react quickly to new problems as well as perform technology transfer functions that facilitate the use of products and information developed in the program by operational Forest Service (FS) personnel.

MTDC worked on eight projects in FY 96 under the MTDC/FHP Technology Development Program and two additional FHP projects, one that originated as a direct transfer of funds during FY 96 and one that is operating on a transfer of funds from Region 8. The year was productive with progress made on all projects. The primary change in the program over the course of the year was a redistribution of resources from Non-chemical Orchard Cone Sanitation (3E32P11). This change was due to entomological conditions at the seed orchard and allowed the program to take advantage of opportunities that developed in other projects to meet near term customer needs.

This was an important year for the MTDC/FHP program as it became integrated into the Forest Health Technology Enterprise Team (FHTET) organization established by FHP. Considerable effort was expended in demonstrating MTDC capabilities to FHTET and MTDC is pleased to be associated with the team. Ann Bartuska, Director, FHP, and her staff were briefed twice on the progress and direction of the MTDC/FHP program. The FHTET Steering Committee was also briefed through a poster presentation at their annual meeting in Ft. Collins, CO. Regular contact is kept between Harold Thistle, MTDC/FHP program leader and Jack Barry, FHTET sponsor.

The program published 11 documents in FY 96 with five others written and either in press, draft, or review as of this writing. Of the 11 publications, one is a peer reviewed journal article, one is a collaborative effort on a book chapter, six are proceeding or symposium papers, and three are MTDC reports.

MTDC deployed meteorological systems twice in FY 96 to support project work as described below. Of the nine projects, five involved hardware development, six involved software development, and two involved deployment or bench testing of environmental instrumentation.

A.	Technical Services - TE02P18	Project Leader, Harold Thistle (406) 329-3981

Project Description -

The objective is to provide technical services promptly on request and to coordinate program planning support to the sponsoring Washington Office unit. At the request of FHTET, MTDC conducts special investigations and studies; participates in field programs; contacts field personnel to determine instrumentation and equipment needs; delivers presentations on forest health protection methods at training sessions, meetings, and workshops; provides follow-up services on completed development projects and answers requests for information from field units, government agencies, and industry; publishes reports; prepares manuscripts for journal publications; and handles program planning and Washington Office coordinator activities for Forest Health Protection projects at the Center.

Summary -

One peer review journal article was published in FY 96 and one book chapter. Harold Thistle gave presentations at six professional meetings. Field support was given in Regions 6 and 8. MTDC personnel traveled to Boulder, CO to meet with FS research and to Ft. Collins, CO and Phoenix, AZ to meet with FHTET steering committees on the FHP/MTDC program. An equipment demonstration was held in Missoula, MT which primarily attracted Region 1 personnel. Cooperators include Department of Energy (DOE), U.S. Air Force, U.S. Army, Canada, and New Zealand. Specifics of these activities are discussed under the relevant projects.

Action Items -

1. Attend national meetings and workshops, present papers and prepare manuscripts for journal publication.

   Papers presented and/or published under this task are:

   Barry, J.W. and H.W. Thistle. 1995. Developing technology - A forest health partnership. In *proc. of the 1995 national silviculture workshop*, 145-152. Sponsored by USDA Forest Service, Timber Management and Forest Management Research Staffs, Washington, DC. Mescalero, NM, 8-11 May.

   Herzberg, D., N. Rappaport, and P. Pierson. 1995. Single tree spray system: Progress report. 9534-2850-MTDC. USDA Forest Service, Missoula Technology Development Center, Missoula, MT.

   Thistle, H.W. and J.W. Barry. 1996. Meteorology and aerial spraying of forests: Status of on-going work in USDA Forest Service technology and

development. In *proc. of the 1995 society of american foresters convention*, 162-267. Portland, ME, 28 October - 1 November 1995.

Thistle, H.W. 1995. Physical modeling of pesticide operations to improve efficacy and reduce off-target effects (Abstract). In *proc. of the pesticide science workshop*. Davis, CA.

Technical Meetings Attended -

Society of American Foresters	**Portland, ME**	**Presentation**
Pesticide Science Workshop	**Davis, CA**	**Presentation**
American Meteorology Society	**Atlanta, GA**	**Presentation**
DGPS Aircraft Guidance Workshop	**Winnipeg, MB**	**Presentation**
American Mosquito Control Association	**Norfolk, VA**	**Presentation**
FS Remote Sensing Conference	**Aurora, CO**	**Presentation**
American Society of Agricultural Engineers	**Phoenix, AZ**	**Presentation**

2. Act timely on routine requests and inquiries, including publishing, illustrating, and photo.

MTDC supported the FHP WO sponsor with routine requests for photography documenting project work. A meeting was held between the sponsor and Bert Lindler to discuss possible approaches to publishing the complex terrain meteorology handbook that is a cooperative effort between FS, U.S. Army, National Weather Service (NWS), and DOE. Publishing and layout were productive this year with 11 documents published and many more currently in draft, review, or in press.

3. Provide meteorology support to FHP field projects.

MTDC deployed a meteorological tower in support of a pesticide spray drift trial conducted in Missoula, MT to test a two-phase sampler for use in pesticide drift studies. MTDC provided extensive meteorological support including deployment of three sonic anemometers on a 100 foot tower, a SoDAR and three EMCOT towers to describe in-canopy dispersion of pheromone. This measurement program was performed in conjunction with a flow visualization study being conducted by Oregon State University. The MTDC/FHP program also lent equipment support to the MTDC Fire and Aviation Program which instrumented a vehicle burn over.

4. Coordinate MTDC project capabilities with requests from Regions, NA, WO, and FHP units.

There was extensive interaction with the Regions and Regional FHP units in FY 96.

Regions 1 and 6 provided technical support and guidance to the aerial sketchmapping project. Region 6 and personnel on the Gifford Pinchot National Forest interacted extensively with us during MTDC meteorological support of the Wind River pheromone dispersion work. MTDC has been working with the Oconto River Seed Orchard in Region 9 on seed orchard sanitation. Region 8 has been a major contributor to our DGPS aircraft guidance work as well as pesticide drift modeling. MTDC is co-authoring a publication on gypsy moth habitat with FHP personnel from Region 4. Region 3 personnel led us on an extensive field trip in northern Arizona after the Spray Model and Application Technology Steering Committee meeting. MTDC attended an information sharing meeting with FS Research in Denver, CO and participated in FS Research panel review.

It is routine practice to keep in regular (typically daily) contact with the WO sponsor. This allows MTDC to react quickly to WO requests and needs as they arise.

5. Complete reports for terminated projects and status reports.

Significant effort was expended this fiscal year in completing reporting on the single-tree sprayer project. An interim report was completed and published in November 1995 and a final report is currently in press and will be published shortly. Several Regions and the private sector have shown interest in this project.

There was unprecedented activity this FY in reporting on the program and soliciting feedback through presenting the program. This task has been split off into a separate section of this report (see Item K. below).

6. Initiate new projects as directed by the FHP/WO sponsor (assignments subject to revision).

The program has been restructured this year under the guidance of FHTET. Most of the projects have been altered either in description, objective, or both. A project to support development of pheromone application equipment has been added. Modeling support projects have been modified to focus on model application and Decision Support Systems (DSS).

B.	Computer Modeling and Technical Transfer of Computer Models	Project Leader, Harold Thistle (406) 329-3981

Project Description -

The objective of this project is to support the technical transfer of models that support the safe and effective application of pesticides. Mathematical models have been developed that use descriptions of meteorological processes and descriptions of application methods and equipment to

simulate dispersion and deposition of airborne materials. Analysis of data is on-going and models have been improved and verified based on field trials by the FS and cooperators. Training in the use of the models began in FY 88 and continues.

Summary -

MTDC authored a proceedings paper on the interaction of aircraft wakes with the ambient atmosphere. MTDC has been involved this year in testing the Forest Service Cramer-Barry-Grim (FSCBG) aerial spray dispersion modeling system for conservation of mass, the incorporation of stability effects into the near-wake model, the integration of DGPS and FSCBG into the Gypsy Moth Expert System (GypsES) modeling system, and real-time applications.

Action Items -

1. Continue technology transfer of the FSCBG modeling system.

   MTDC worked closely this year with Environment Canada on the promulgation of parts of the FSCBG model into regulatory use in Canada. A question was raised regarding conservation of mass in FSCBG and MTDC did a number of runs to evaluate this concern.

   MTDC has been working with Region 8 and the FS GypsES model developers to incorporate FSCBG into GypsES. This effort was pursued by Continuum Dynamics, Inc. (CDI) in cooperation with FS personnel and has yielded a powerful tool which combines FSCBG output with a Geographical Information System (GIS) map base to yield easily interpretable coverage information. MTDC has also been involved in the incorporation of DGPS aircraft guidance into the GypsES model. MTDC has also begun work with CDI on development of an algorithm to describe the interactions between ambient atmospheric stability and aircraft wakes.

   A proceedings article was published discussing atmospheric dispersion modeling -

   > **Thistle, H.W. and M.E. Teske. 1996. Incorporation of stability effects into a lagrangian solver used to model wake and ambient dispersion in the atmosphere. In *preprint volume of the ninth joint conference on the application of air pollution meteorology with A&WMA, AMS.* Boston, MA. Atlanta, GA, 18 January - 2 February.**

2. Support incorporation of the FSCBG modeling system into decision support systems such as GypsES and into expert systems such as those being developed by USAF.

   Harold Thistle presented a paper on GypsES to the Differential Global Positioning System (DGPS) Aircraft Guidance Workshop in Winnipeg, MB. This paper was given on behalf of John Ghent, FS Asheville, NC, who could not attend. Harold

Thistle also attended a planning session in Morgantown, WV which was attended by Alan Bullard, Director, FHTET-Morgantown and John Barry, Director, FHTET-Davis; the GypsES model developers; Terry Biery, USAF; and Bob Mickle, Environment Canada. The integration of FSCBG into GypsES is on-going and MTDC is acting as a technical advisor.

3. Assist FSCBG User Group in conducting training sessions and in keeping user materials and information current.

MTDC works with FS contractor, Continuum Dynamics, Inc. (CDI), Princeton, NJ to aid in the effective technology transfer of FSCBG. MTDC is in close contact with Bob Mickle, Environment Canada, who has been the catalyst in implementing FSCBG as a regulatory tool in Canada. MTDC answers technical questions and evaluates technical concerns to evaluate new avenues for model development and improvement.

4. Complete interface of complex terrain spray drift model (VALDRIFT).

Two proceedings articles were published this year discussing progress on VALDRIFT. These will be discussed under the complex terrain project. A validation exercise using the Utah 1991-1993 Wasatch Front pesticide drift data sets has begun with the building of model input streams. The current thinking on this problem is that VALDRIFT will stand alone with a specific set of instructions on how to run FSCBG to output information that will be used as input to VALDRIFT.

5. Incorporate the latest knowledge on droplet evaporation and droplet size distribution into the FSCBG system.

CDI has enhanced the non-water evaporation algorithm in FSCBG based on new data, largely gathered by the Spray Drift Task Force (SDTF).

6. Research and improve algorithms which describe canopy interception of spray droplets.

Work is on-going analyzing data and investigating new modeling approaches. This is discussed under Project *Meteorological and Vegetative Factors in Pesticide Drift* (see Item F.).

7. Continue to provide support for systems management and implementation of existing models plus support the introduction and application of new models.

MTDC will be involved in the adaptation of existing modeling techniques into the new Project 615 workstation network which is now partially operational at MTDC. MTDC has opened discussion with FHP/Morgantown to cooperate on the movement of FSCBG into a Windows environment in conjunction with the integration of

FSCBG into GypsES.

C.	**Pheromone Application Support**	**Project Leader, Andy Trent (406) 329-3912**

Project Description -

The overall objective is to help make available equipment and procedures for applying pheromone both aerially and from the ground. Methods and equipment need to be investigated, evaluated, and possibly adapted or developed for dispersing pheromone in tubes, capsules, flakes, pellets, and granules. Investigate solid dispersal systems, how pheromones are currently dispersed, and in what forms they can be obtained. Included is the necessary familiarization and training in related software and test procedures, as well as planning and coordination. Field testing will be accomplished, hardware modified if necessary, and progress documented.

Summary -

This project was initiated by a transfer of funds ($2K) from FHP/Morgantown. The Project Leader, Andy Trent, participated in aerial pheromone application operations out of Blacksburg, VA and has developed objectives for an MTDC/FHP project in FY 97.

Action Items -

A set of actions is being developed as this project is beginning. MTDC had a pheromone application project in previous years which was subsequently terminated. This project is being initiated based on direct field needs expressed by both FHTET-Davis and FHTET-Morgantown. Other work related to pheromone dispersion is described under the *Meteorological and Vegetative Factors in Pesticide Drift* project (see Item F.)

D.	**GPS Based Aircraft Navigation and Guidance**	**Project Leader, Harold Thistle (406) 329-3981**

Project Description -

The objective of this project is to evaluate DGPS guidance tracking systems for spray aircraft. In aerial spraying it is important to apply pesticide as accurately as possible in order to improve its efficiency and thereby reduce costs and unintended impacts on the environment. It is also important to know aircraft location in real-time and to have a permanent record of its flight patterns. The guidance systems assist the pilot in the precise application of the material and tracking is needed to provide a record of where the aircraft flew for later analysis of the operation,

or input into GIS for future information and possible future litigation. In the post analysis of the operation, skips can be determined and respray accomplished.

Summary -

A demonstration of the Trimble differential GPS (DGPS) aircraft navigation system was conducted near Missoula, MT in October 1995. Two reports and one book chapter were published on this project in FY 96. Harold Thistle presented project findings to the DGPS Aircraft Guidance Workshop in Winnipeg, MB in February 1996. MTDC is monitoring this technology as it develops and future testing is being planned.

Action Items -

1. Conduct evaluation and demonstration of GPS based aircraft guidance and navigation equipment in complex terrain.

   The primary testing was completed in FY 95. A follow-up demonstration was conducted in October 1995 (FY 96) which involved Trimble Navigation Systems. Trimble contacted MTDC and requested that they be allowed to demonstrate to us. They had declined our invitation to participate in the previous testing exercises.

2. Prepare a comprehensive report of FS experience and evaluation results.

   Two reports were published reporting on aspects of this work in FY 96. The first is the final report on the FY 95 testing and was released at the beginning of FY 96, the second was a short write-up of the Trimble testing:

   Thistle, H.W., A. Jasumback, W. Kilroy, K. Mierzejewski, and J. Barry. 1995. DGPS in aerial spraying in forestry: Demonstration and testing. Final Report 9535-2848-MTDC. USDA Forest Service, Missoula Technology and Development Center, Missoula, MT.

   Thistle, H.W. 1996. Differential GPS aircraft navigation - Resource inventory and positioning demonstration. 9634-2324-MTDC. USDA Forest Service, Missoula Technology and Development Center, Missoula, MT.

3. Keep abreast of this technology and maintain expertise in the field.

   MTDC continues to actively monitor this technology. The incorporation of this technology into control systems is an area of interest. A book chapter based on a previously presented paper has been published in this area:

   Teske, M.E., J.W. Barry, and H.W. Thistle. 1996. FSCBG predictions coupled to GPS/GIS aircraft tracking. In *Pesticide Formulations and*

Application Systems: 15th Volume, ASTM STP 1268, **eds. H.M. Collins, F.R. Hall, and M. Hopkinson, 15-28. Philadelphia: American Society for Testing and Materials.**

E.	**Computer Assisted Sketch-Mapping**	**Project Leader, Harold Thistle (406) 329-3981**

Project Description -

The advent of GPS positioning and high-speed, computer-based GIS systems is influencing many established, hard map-based procedures. In forest health aerial survey work, it may be feasible to replace hand marking of topographic maps by directly entering infestation data into a GIS system which scrolls a moving map based on input from a GPS unit. This type of moving map display exists but the logistical considerations involved in integrating, installing, and operating this type of airborne system are substantial. This type of system has broad applications both inside and outside of FHP.

Summary -

MTDC, Remote Sensing Applications Center (RSAC), FHTET, and Region 1 personnel attended a demonstration of a prototype digital sketch-mapping system in British Columbia. A project meeting was held with the operational sketch-mappers at the FS Remote Sensing Conference. An interim report is being prepared and equipment needs evaluated.

Action Items -

1. Exactly define the procedure as currently performed.

   MTDC has been working closely with Tim McConnell of Region 1 who is currently the sketch-mapper in Region 1 and also has sketch-mapping experience in Region 6. A survey of operational sketch-mappers was conducted in FY 95. An informal meeting was called in Aurora, CO at the FS Remote Sensing Conference to review the project and the approach being taken with the FS operational sketch-mapping community. This task is completed.

2. Survey manufacturers for off-the-shelf systems which do this. Possible candidates would be in photogeology, law enforcement, urban mapping, wildlife management, etc. Find out if similar systems exist elsewhere in the FS.

   This task is on-going and the state-of-the-art in this technology is changing rapidly. However, a prototype system was identified by Tim McConnell being flown in British Columbia. A team travelled to Williams Lake, BC to observe this system in

operation. It is very close to an operational system. Some of the questions that remain regarding this system are ones of software transportability, screen size and glare, and incorporation of a pen-based operating system.

3. Develop an integrated prototype system. The system will have a moving map display tied to a GPS positioner. It will allow easy data entry (probably mouse or touch input). It will pass any and all FAA requirements for use in an aircraft and will be easy to install.

   The prototype already exists and is being flown by BC Provincial Forestry. The primary personality in the development of this has been Leo Rankin of BC Forestry. MTDC will act this year to begin filling some of the equipment holes mentioned above. RSAC is working on questions of software and map bases.

4. Evaluate the system in actual use. This will involve test flying the system.

   The BC prototype was evaluated in use. It still has limitations as described. It is planned to begin experimenting with different screen and input technologies in the BC prototype to resolve the remaining issues.

5. Prepare a summary performance report.

   Preparation of an interim report will begin by the end of FY 96. MTDC will use this as a termination report and project responsibility will be handed to RSAC.

6. Support implementation of this technology in the FS.

   The project has begun by contacting the operational sketch-mappers in the FS and asking them for input. It is hoped that by keeping the operational users involved in the development process technology transfer will be facilitated. RSAC has been assigned responsibility for this project beyond FY 96.

F.	**Meteorological and Vegetative Factors in Pesticide Drift**	**Project Leader, Harold Thistle (406) 329-3981**

Project Description -

With significant concern over drift and fate of pesticides in the environment, focus is being shifted toward the small amount of material that becomes entrained in the ambient atmosphere and moves significant distances away from the intended target. This off-target movement or drift is largely controlled by ambient meteorological conditions. Though the primary effects of variables such as wind direction and speed are apparent, less intuitive effects due to temperature gradients (stability), humidity, solar radiation, and other variables can have order of magnitude effects on

the amount of off-target drift in certain situations.

Plant canopies are often the target of pesticide application either directly or through their role as food source or habitat for destructive insects. Therefore, the ambient environment in and near the plant canopy could influence the efficacy of the application. The objective of this project is to review and evaluate the state-of-the-art in understanding the ambient environment and micro-meteorology inside plant canopies and to determine which variables are important and which are not in predicting in-canopy spray behavior. With the computational techniques and models now available to the FS, efforts can be directed to determine which variables will be influential and to focus effort on the nature of these in the canopy.

Summary -

Presentations were given on this topic in FY 96 at the Society of American Foresters in Portland, ME and at the American Mosquito Control Association in Norfolk, VA. An extensive field program to investigate dispersion of pheromone in Douglas Fir was conducted. A small field trial was run with a New Zealand cooperator. One peer reviewed journal article was published on this topic.

Action Items -

1. Prepare a review journal article for American Society of Agricultural Engineers (ASAE) on the nature of atmospheric stability and the relation between atmospheric stability and dispersion.

   A peer review journal article was published:

   Thistle, H.W. 1996. Atmospheric stability and the dispersion of pesticides. *Journal of the American Mosquito Control Association* 12(2):359-363.

   A more theoretical article is in preparation for *Transactions of the American Society of Agricultural Engineers*.

2. Conduct a dispersion field test to ascertain the role of atmospheric stability in pesticide drift.

   The stability dispersion tests which had been planned for last February were canceled due to logistics and the shifting of cooperator priorities. However, substantial interest in these trials was expressed at the Spray Model and Application Technology Steering Committee meeting this summer in Phoenix, AZ. These trials are tentatively scheduled for next summer.

3. Assist in preparation of meteorological guidance document for pesticide applicators.

A comprehensive guidance primer of mountain meteorology and how it effects forestry weather dependent operations is being partially sponsored by MTDC and FHTET-Davis. Cooperators in this effort include National Weather Service, Department of Energy, and the U.S. Army. A portion of this book will be devoted to pesticide application. The first part of the book will be in review this fall. MTDC and FHTET-Davis will have responsibility to write a chapter on weather dependence in pesticide application and are serving on the Editorial Board.

4. Identify role and importance of monitoring various atmospheric variables in different situations.

Two field projects were conducted in FY 96 to investigate the role of the atmosphere in dispersion of pesticide. A small near-field test was conducted in Missoula by MTDC with cooperator Bill May of Lincoln Ventures (formerly the Agricultural Engineering Institute) of Hamilton, NZ. In this test nine vacuum pumps, a two-phase sampler, three sonic anemometers and other meteorological instrumentation were arrayed to monitor puffs of insecticide from a backpack sprayer.

The second program was a substantial effort in which Harold Thistle, Mike Huey, and Mark Wiggins traveled to Carson, WA to set up and operate meteorological instrumentation in conjunction with an in-canopy smoke visualization study. This study was conducted on the site of the Wind River canopy crane to investigate dispersion of pheromone in the mixed Douglas-fir/cedar canopy. The meteorological instrumentation involved three sonic anemometers, a soDAR, and three 7 meter instrumented towers. The meteorological program, which was run in conjunction with the smoke releases, was a success.

5. Continue training of applicators in the importance of atmospheric variables.

Harold Thistle talked at the annual meeting of the American Mosquito Control Association on the relationship between pesticide dispersion and meteorology. Mosquito control is a major industry and one of the largest users of insecticides.

G. Pesticide Drift in Complex Terrain — Project Leader, Harold Thistle (406) 329-3981

Project Description -

The drift of pesticides in complex terrain presents a special set of problems due to the environmental setting. Lateral dispersion is typically restricted by mountain or valley sides while downwind dispersion is typically enhanced by the prevailing wind fields in mountain valleys. The

problem is to develop a model which will allow planning and analysis of aerial spraying operations in complex terrain. Much of the FS land is mountainous and FS personnel face mountainous pesticide application scenarios when dealing with defoliators such as the gypsy moth.

Summary -

There were two major thrusts of this project this year. The first was the validation exercise of VALDRIFT which was begun and the second was the cooperation in the publication of an operational guide to complex terrain meteorology. Two proceedings papers were published.

1. To incorporate the VALDRIFT model into the FSCBG modeling system.

   The approach will be to validate VALDRIFT as a stand-alone model and then develop guidance to generate parts of the input from FSCBG. A proceedings paper was published:

   > **Allwine, K.J., X. Bian, C.D. Whiteman, and H.W. Thistle. 1996. VALDRIFT - A valley atmospheric dispersion model with deposition. In *Preprint volume of the ninth joint conference on the applications of air pollution meteorology with A&WMA*, 605-608. Sponsored by the American Meteorological Society, Boston, MA. Atlanta, GA, 18 January - 2 February.**

2. To validate VALDRIFT on existing complex terrain pesticide drift data.

   The validation exercise was begun this year with the Bt drift data from the 1991-93 Utah Gypsy Moth Eradication Program being used to build a model run or comparison to that data. A proceedings paper was published:

   > **Thistle, H.W. , K.J. Allwine, C.D. Whiteman, X. Bian, and J.W. Barry. 1996. Validation of the VALDRIFT 1.0 complex terrain pesticide dispersion model. ASAE Paper No. 961079. St. Joseph, MI:ASAE.**

3. To collect a complex terrain pesticide drift data set in an operational environment and use these data to validate VALDRIFT.

   The planned field project to collect data in the Bitterroot Mountains of western Montana has not materialized due to delays in approval of the necessary environmental documents submitted by the local FS district. This task will probably be fulfilled after validation and could be used to research deficiencies in the model.

4. Prepare a journal article describing the VALDRIFT validation work.

   A journal article has been accepted for publication in the *Journal of Applied*

Meteorology. **It is currently undergoing final revision.**

5. Review advances in the study of complex terrain atmospheric dispersion as well as the atmospheric transport of aerosol clouds.

Involvement in the preparation of the guidebook to complex terrain meteorology has kept MTDC up-to-date on thinking regarding complex terrain dispersion. Harold Thistle, MTDC, traveled to Salt Lake City, UT to participate in an editors' meeting with National Weather Service (NWS), FHTET, and U.S. Army personnel and discuss the state-of-the-art in complex terrain meteorology. MTDC was involved in two articles presented at the American Meteorological Society symposium on air pollution and is in touch with current thinking regarding atmospheric dispersion.

H. Non-chemical Orchard Cone Sanitation — Project Leader, Keith Windell (406) 329-3956

Project Description -

Non-chemical orchard sanitation techniques such as sweeping, burning, debris removal, and steaming may be effective and practical means of controlling cone, duff, and associated seed and cone insects from seed orchards. Infestations such as cone beetle have a substantial economic impact on seed orchards and orchard managers are searching for effective non-chemical methods to combat these pests.

Summary -

The main field program which was planned for this project this year was a burner trial at the Oconto River Seed Orchard in Wisconsin. This trial was proposed to answer questions raised in a trial conducted in FY 95. This trial was postponed due to the low beetle population this spring which could affect the statistical significance of the efficacy trials. Project leader, Keith Windell, has postponed that trial to FY 97. Keith is investigating equipment used in nut harvesting and turf cleaning as alternative technologies. Weyerhaeuser is interested in cooperating on this project.

Action Items -

1. Follow-up on equipment leads that were developed under the Thermal Insect Control Project. The most promising equipment for control of cone insects on the orchard floor is sweeper technology. Other potentially useful technology includes mechanical disruption of cones or duff layer (chopping) or possibly steaming.

Keith Windell has investigated the use of pecan harvesters for this application. Initial indications are that this may be a cost prohibitive approach to this problem

although the technology might be applicable. Keith traveled to Coeur d' Alene, ID to investigate the use of a turf sweeper. This technology is relatively low cost and a modified version could be applicable. Thermal techniques beyond burning, such as steamers which are currently being investigated by MTDC under the Reforestation and Nurseries Program to replace methyl bromide fumigation, are also under investigation.

2. To perform field trials on potentially useful equipment with success being based on efficacy, economics, safety, and practicality.

   A field trial to finalize the investigation of the propane burner technology was scheduled this year at Oconto River Seed Orchard in Wisconsin. Bill Sery contacted MTDC this spring and indicated that the beetle population was so low at that site (possibly a result of the most severe winter on record there) that burner trials would not yield statistically significant results. Keith Windell observed an informal test of a turf sweeper at Coeur d'Alene, ID and believes this technology to be very promising. He is investigating a more formal field trial. The turf sweeper can be purchased in basic form for $6K and might be a functional system for under $10K with attachments and modifications.

3. To prepare a report summarizing the technology and making recommendations which will vary based on biological and regional considerations.

   A summary report will be prepared after the Oconto field trials which will be performed in FY 97.

I.	**Graphical Enhancement of Pesticide Dispersion Models**	**Project Leader, Harold Thistle (406) 329-3981**

Project Description -

Graphical user interfaces are critical to gaining acceptance for FS pesticide dispersion modeling techniques. This acceptance is a necessary first step in building a user base. The user community is becoming increasingly sophisticated and discerning regarding user interfaces. Users interpret outmoded interfacing as implying low technical merit of the model content. This project was initiated to review approaches to upgrading model interface graphics.

Summary -

There are two main thrusts to this project. The first is to develop a graphical interface for VALDRIFT which is currently command-line driven. The second is to investigate approaches to upgrading the FSCBG interface and graphical output which is based on a menu system. Literature

and software packages have been reviewed. A first step in both models is to interface the software into Windows.

Action Items -

1. Review existing software packages.

   Many software packages have been experimented with. FSCBG graphics have been output using Spyglass (Spyglass, Inc.). The marginal improvement that this approach provided was probably not worth the cost to implement the change. The FSCBG interface is under 10 years old and a primary factor in its modernization will be to convert it to Windows. Preliminary discussion has been entered into with Sue Thomas (FS-Morgantown, WV).

2. Investigate animation of model output.

   This task is appropriate for the VALDRIFT model but is not appropriate for FSCBG since there is not time dependence in that model. Model animation may be possible for VALDRIFT with the initial phase to modularize the model and provide a graphics user interface (GUI). Software has been identified which might accomplish this.

3. Update graphical model output.

   Actual updating has not begun but the approaches described above will be pursued.

J. Projects Direct From FHP Regional Staffs

Project Leader, Harold Thistle
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In FY 93 MTDC began discussion with Region 8 to produce a stump head applicator for controlling annosum root rot. This is a machine that applies an anti-fungal agent directly to the surface of a stump as the tree is being cut. The stump head applicator is attached to a feller-buncher and eliminates the need to return to a site to treat stumps. In this application, the machine is being used to prevent annosum root rot. Dick Karsky and Neal Maier of MTDC traveled to Region 8 to test a prototype unit and continue to modify the unit for use in the Southeast.

Annosum root rot is a pervasive disease on the Savannah River Forest Station (SRFS) with the potential to disrupt management objectives for the red-cockaded woodpecker habitat and timber values. This project is a cooperative effort between FS (FHP, SRFS, and MTDC), DOE, Clemson University and Auburn University.

The objectives of this project are:

1. Design and fabricate an "add on" removable stump treatment applicator to any number of feller-bunchers that would treat cut stumps for the purpose of controlling annosum root rot.

2. Evaluate the performance of the stump treatment applicator in the field on an operational level. This includes effectiveness of the stump applicator in obtaining full stump coverage with the approved treatments and evaluating efficacy by monitoring the incidence of root rot before and after treatment with *Phlebia gigantea,* TIM-BOR, and no treatment. Finally, complete a financial analysis for the various options.

To accomplish these objectives, MTDC designed and fabricated an "add-on" removable liquid applicator that could be placed on a number of feller-bunchers for the purpose of stump application. The system consists of a 40-gallon tank, a diaphragm pump, a timer, and one full cone nozzle (1.2 gallons per minute). In order to evaluate the performance of the stump treatment applicator, three stands of longleaf pine, located on high-hazard soils, were selected for thinning and stump treatment. An agreement to continue this activity in FY 97 is being pursued by Region 8.

K.	**The MTDC/FHP Program**	**Project Leader, Harold Thistle (406) 329-3981**

There was extensive activity this year to facilitate communication and understanding between FHTET and MTDC. MTDC staff and Jack Barry, the FHTET sponsor, are in regular communication. Jack Barry visited MTDC in June. The purpose of the trip was to present the program to Jack and to develop a plan of work for FY 97. Ann Bartuska, Director, FHP, and FHTET Directors, Bov Eav and Alan Bullard, were briefed on MTDC and the MTDC/FHP program during a visit to MTDC in June. Ann Bartuska was also briefed on the MTDC/FHP program by Harold Thistle at the Auditors Building in Washington, DC in October. Harold Thistle attended the FHTET Steering Committee meeting in April in Ft. Collins, CO. John Steward, Manager, MTDC, attended the FHTET team meeting in Ft. Collins in August. Keith Simila of WO Engineering has been working extensively with FHTET to organize the Engineering/FHP relationship so that the team is comfortable with the process of getting the program objectives completed.

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Cover Photo: Gallatin Canyon, Gallatin National Forest
1988 Yellowstone Fire Complex, Fire Recovery, June 1966
Photo by John W. Barry